



Armed Forces College of Medicine AFCM



Histological Structure of the Liver

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The Liver



ILOs:

- Describe the basis of the different classifications of hepatic lobules.
- Describe the structure of components of the classic hepatic lobule.
- Correlate the structure of hepatic lobules to their functions
- Describe the light and electron microscopic picture of hepatocytes.
- Interpret the altered microscopic structure of the hepatic lobules & hepatocytes in different diseases.



The Liver

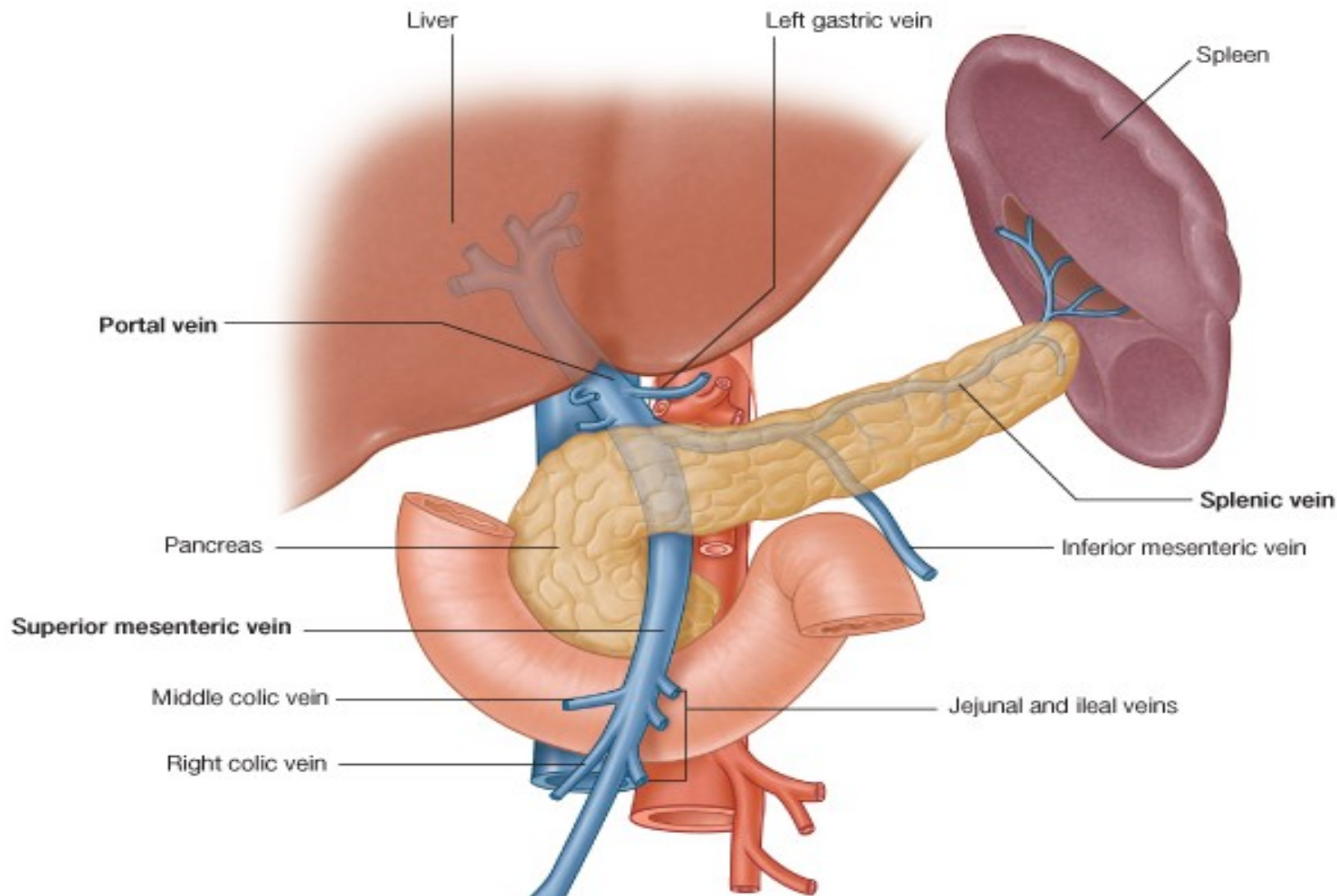


Key Points:

- Classifications of hepatic lobules.
- The structure of the classic hepatic lobule.
- Structure/function relationship of hepatic lobules.
- The microscopic structure of hepatocytes.
- Microscopic alteration of the hepatic lobules & hepatocytes in different diseases.



The Liver



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The Liver



The liver

Compound
tubular
gland

The largest
gland of the
body

**Endocrine
function**

**Exocrine
function**

**Plasma
proteins**

**Bile
secretion**





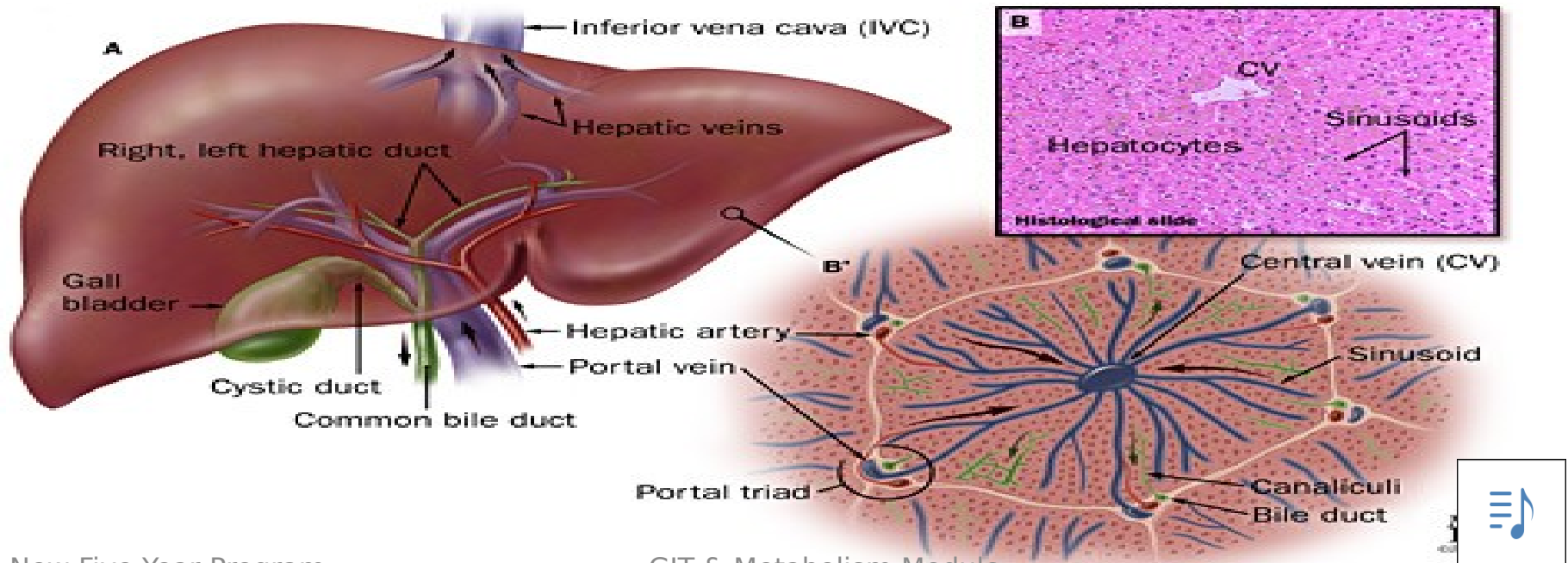
The Liver

Structure of the Liver

STROMA

1. Capsule
2. Trabeculae
3. RCT

PARENCHYMA



Structure of the Liver

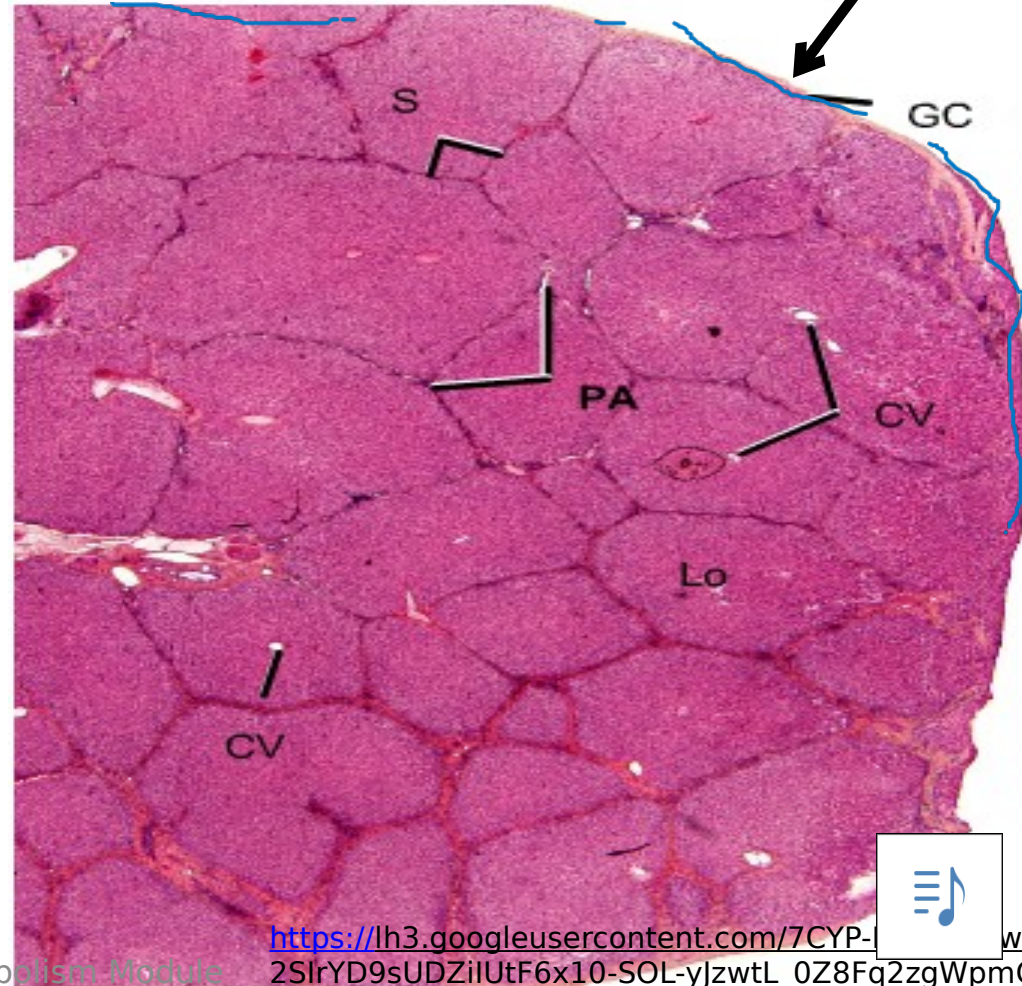


STROMA

PARENCHYMA

1-CAPSULE

Connective tissue capsule (**capsule of Glisson**): Dense CT covered by peritoneum & is thick at the porta hepatis to send septa.



Structure of the Liver



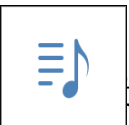
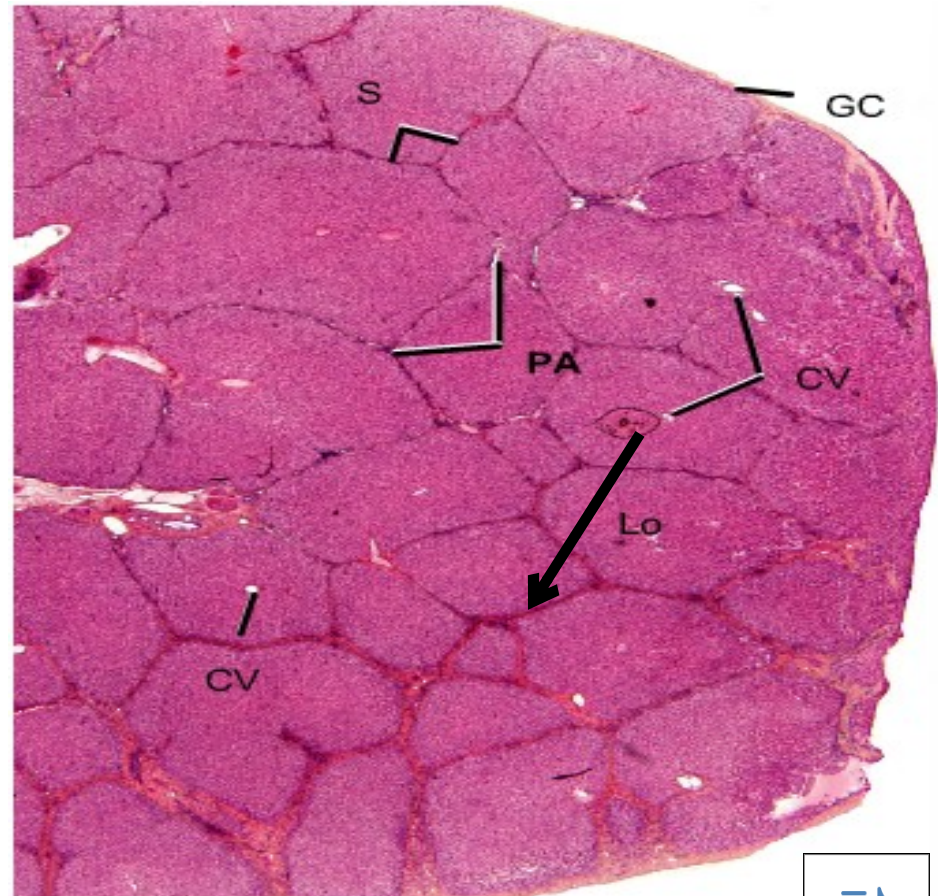
STROMA

2-TRABECULAE



Interlobular septa:
Thin in human but
thick in animals

PARENCHYMA



Structure of the Liver



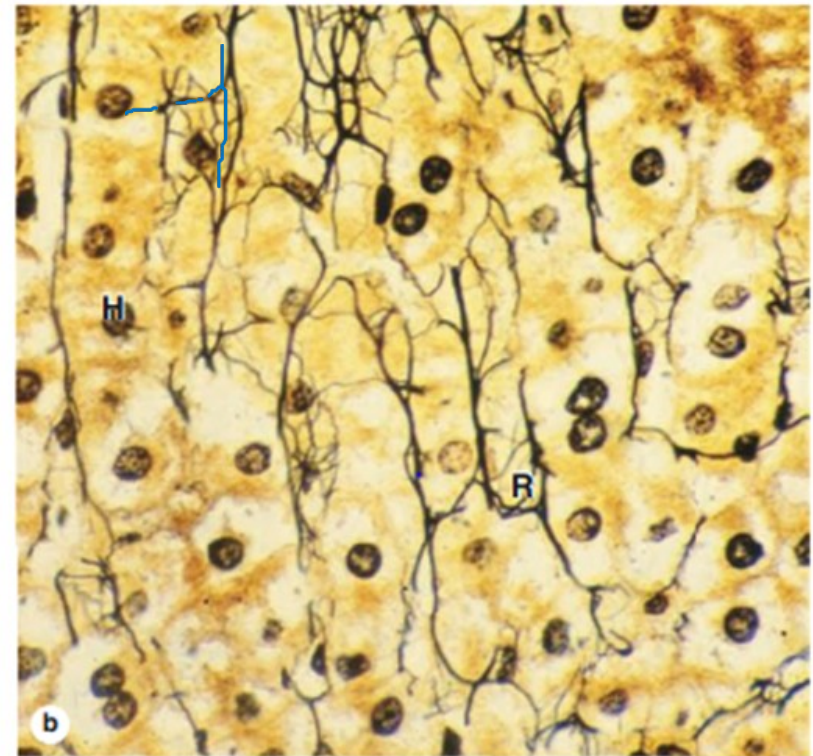
STROMA

PARENCHYMA

3-Reticular connective tissue



Short branching & anastomosing fibers, forming network that holds the cells in their place



Mescher AL: Junqueira's Basic Histology: Text and Atlas, 14th Edition.
<http://www.accessmedicine.com>



STRUCTURE OF the liver

STROMA

PARENCHYMA

Hepatocyte



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Liver Cell
(Hepatocyte)



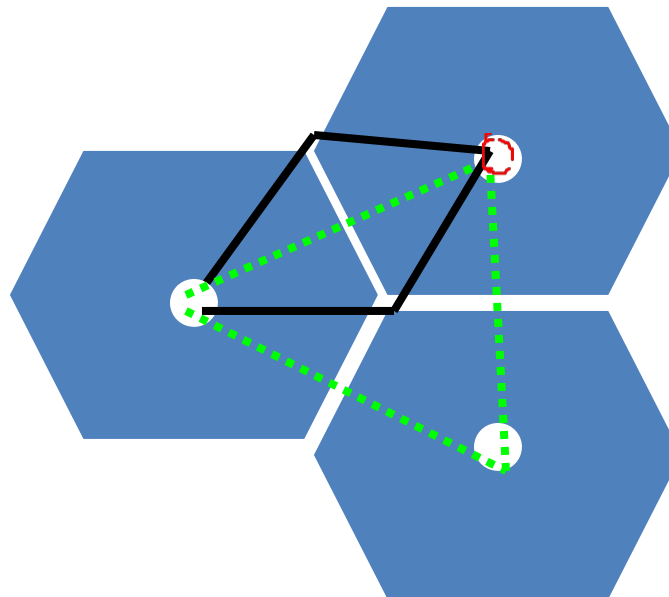
Classification of Hepatocyte organization



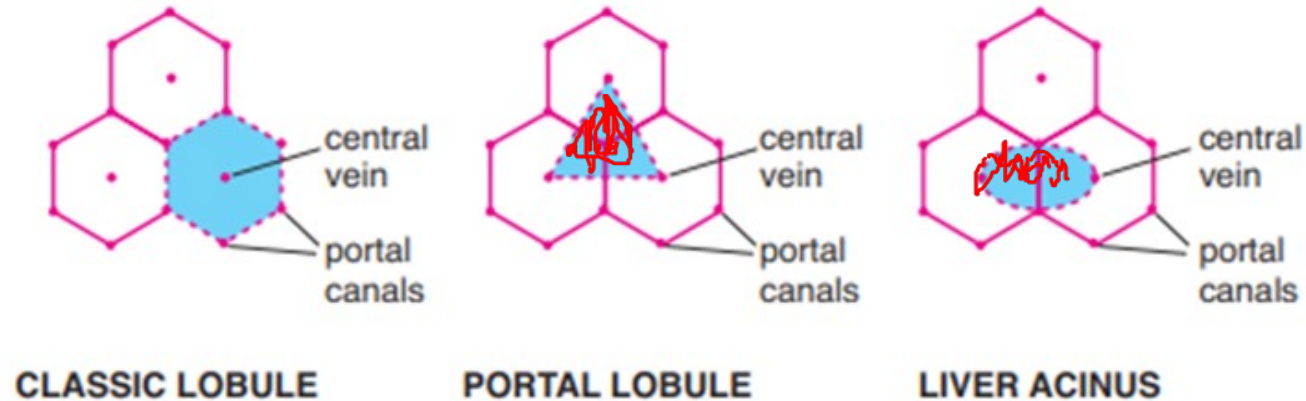
**Liver
acinus**

**Portal
lobule**

**Classic
Hepatic
lobule**



Liver Lobules



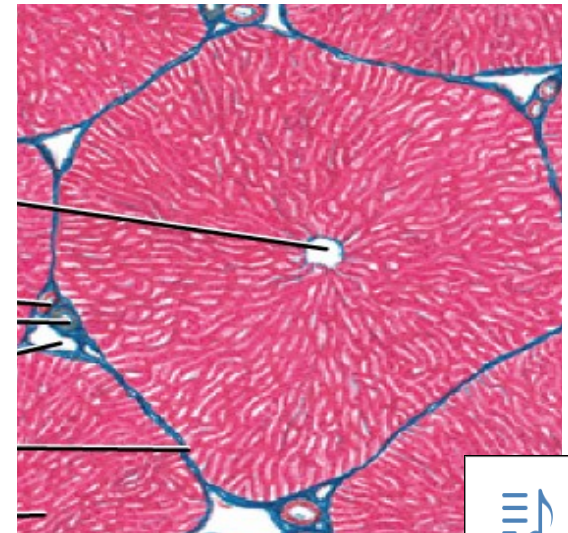
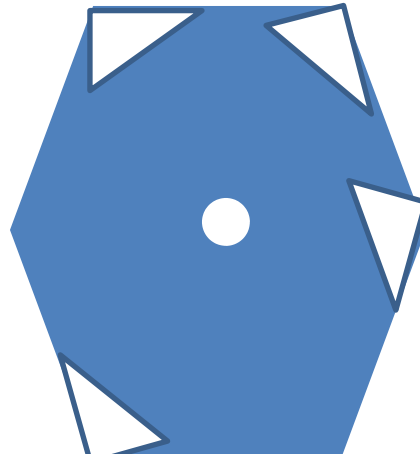
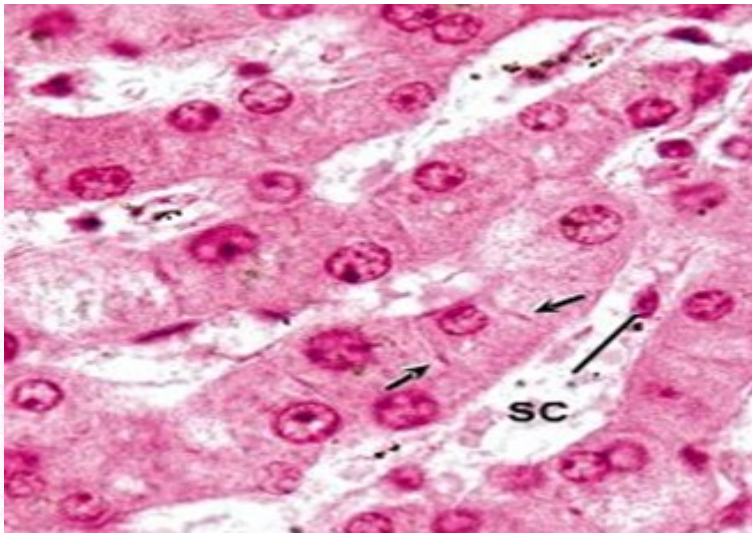
Ross MH, Pawlina W: Histology A Text & Atlas with correlated Cell & Molecular Biology, 6th Edition.



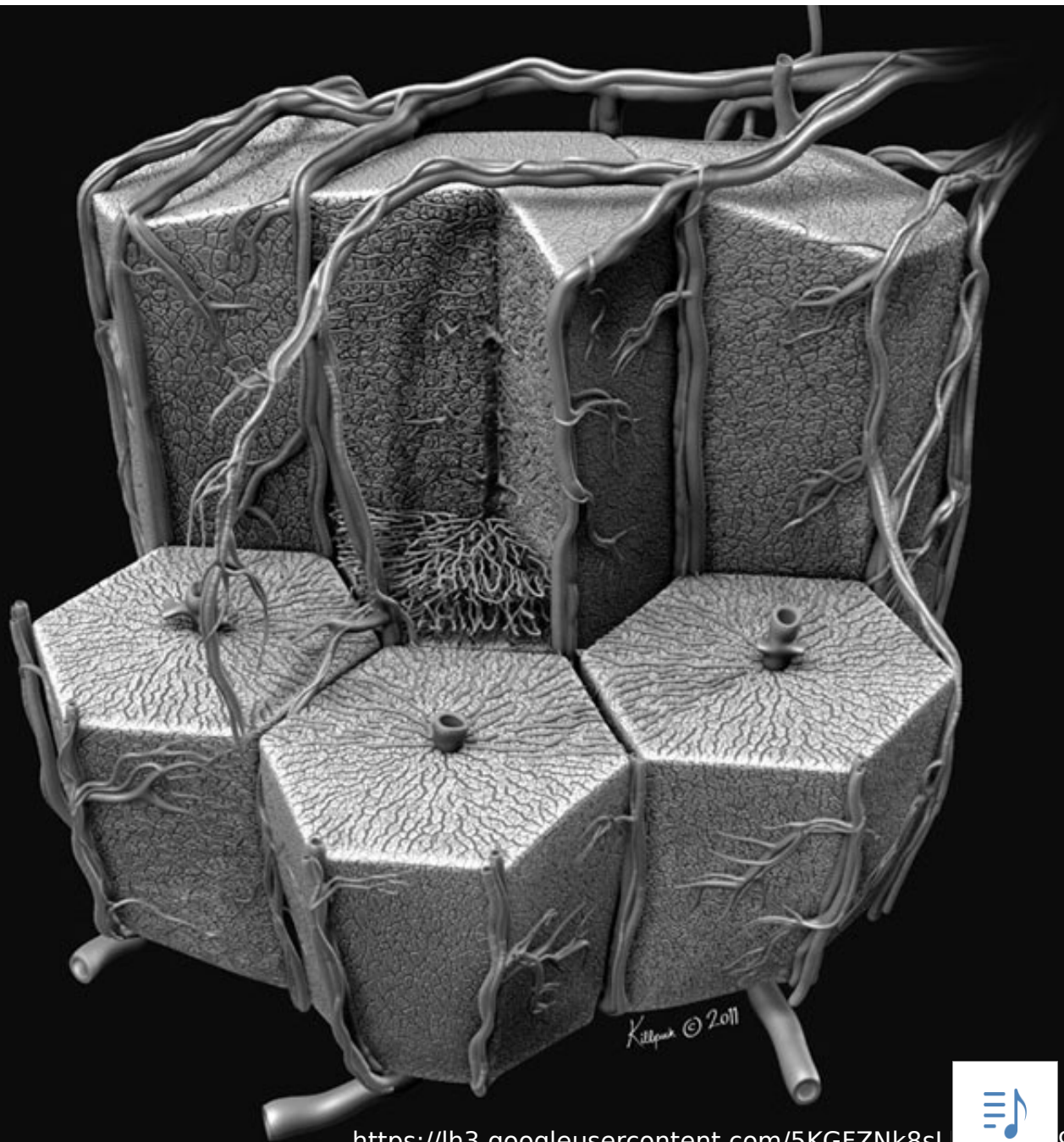
Classic Hepatic Lobule



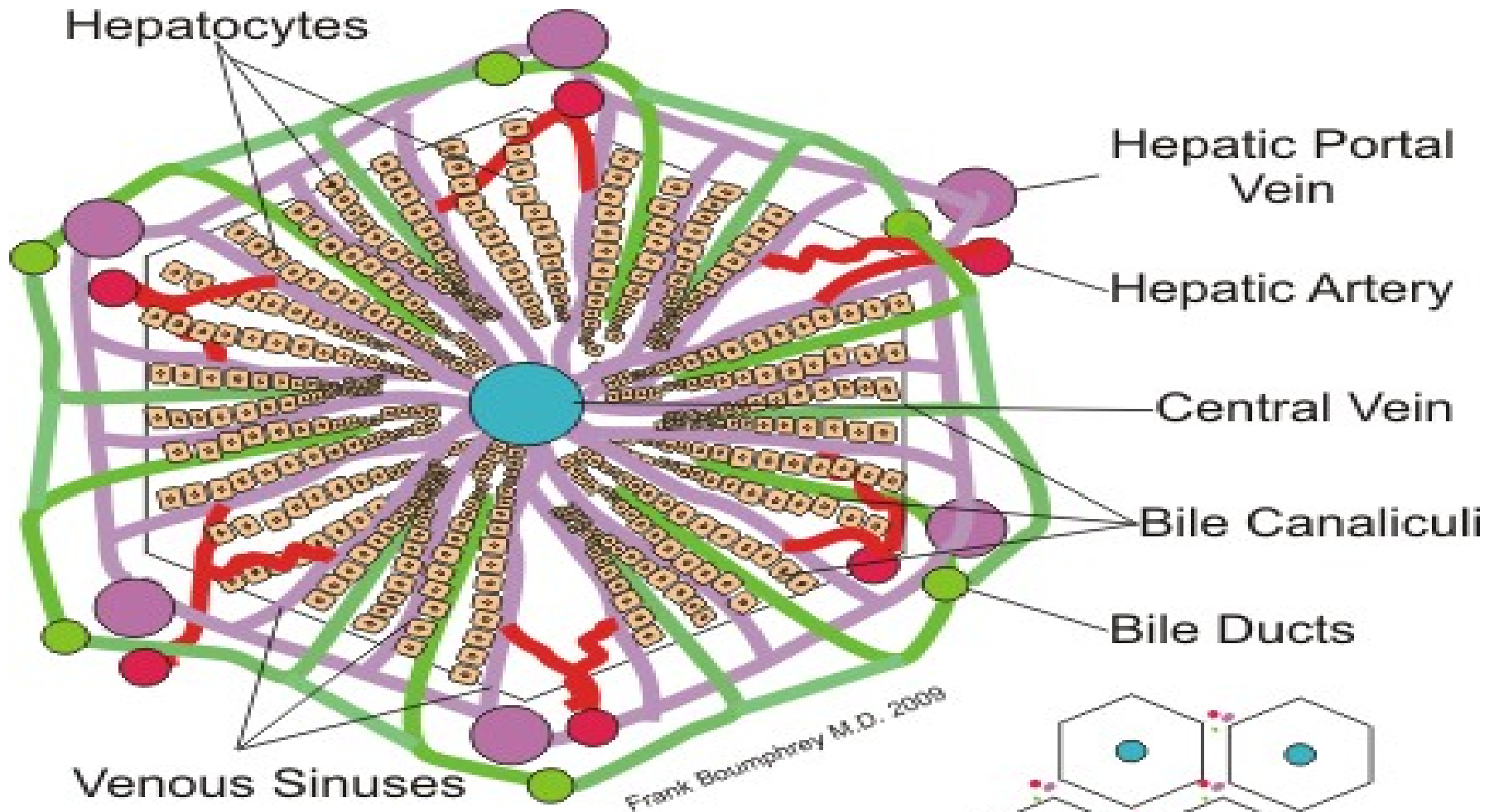
- It is hexagonal in shape.
- The central vein is at the center.
- **Hepatocytes**: branching & anastomosing **CORDS (plates)** radiating from the CV to the periphery.
- The cords of hepatocytes: one or 2 cell thick. & separated by sinusoids.
- At the corners: portal areas are found.



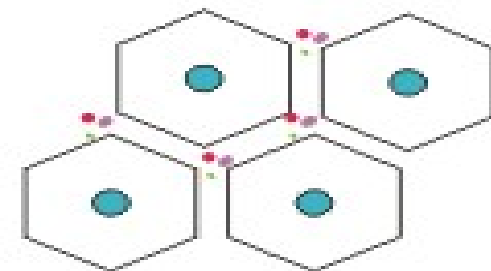
Hepatic Lobules



Classic Hepatic Lobule



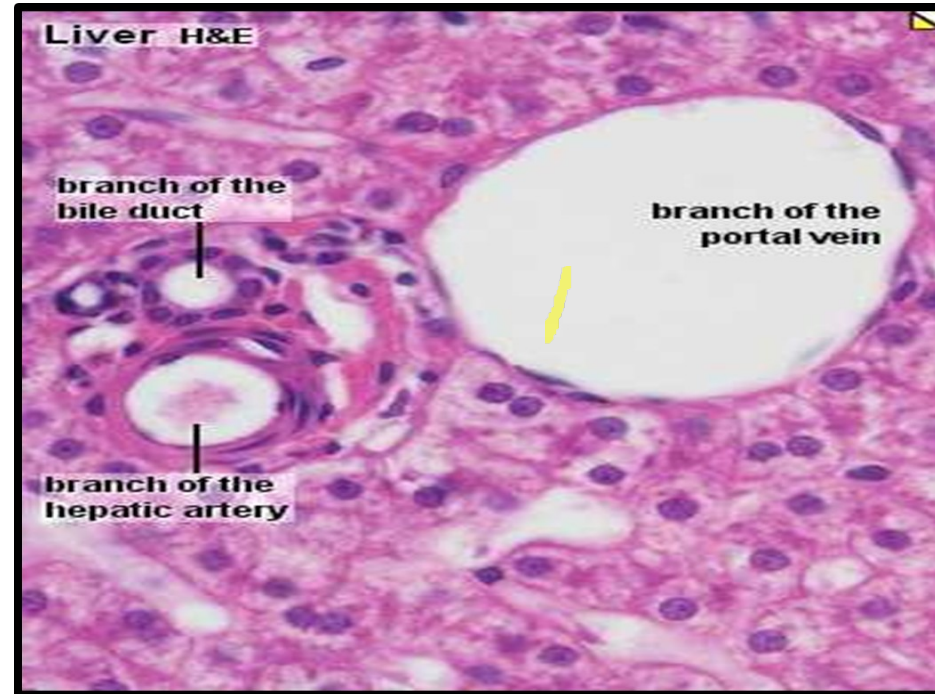
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Portal Tract

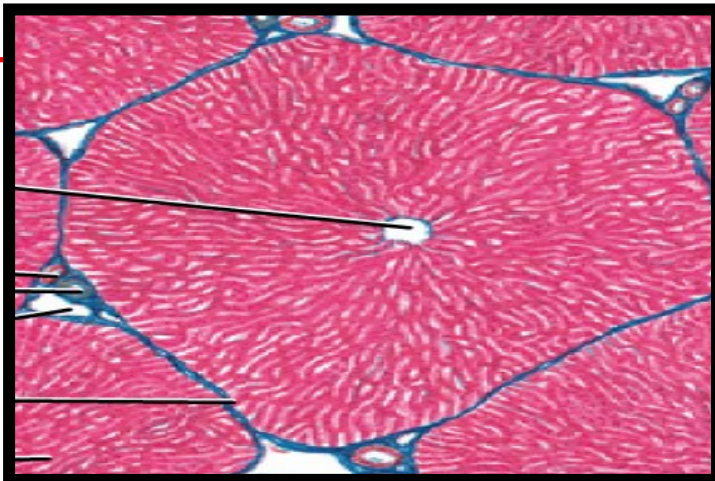


- Found at some of the corners of the classic hepatic lobule.
- It contains:
 1. Branch of the hepatic artery.
 2. Branch of the portal vein (largest).
 3. Branch of the bile duct.
 - 4.



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Question

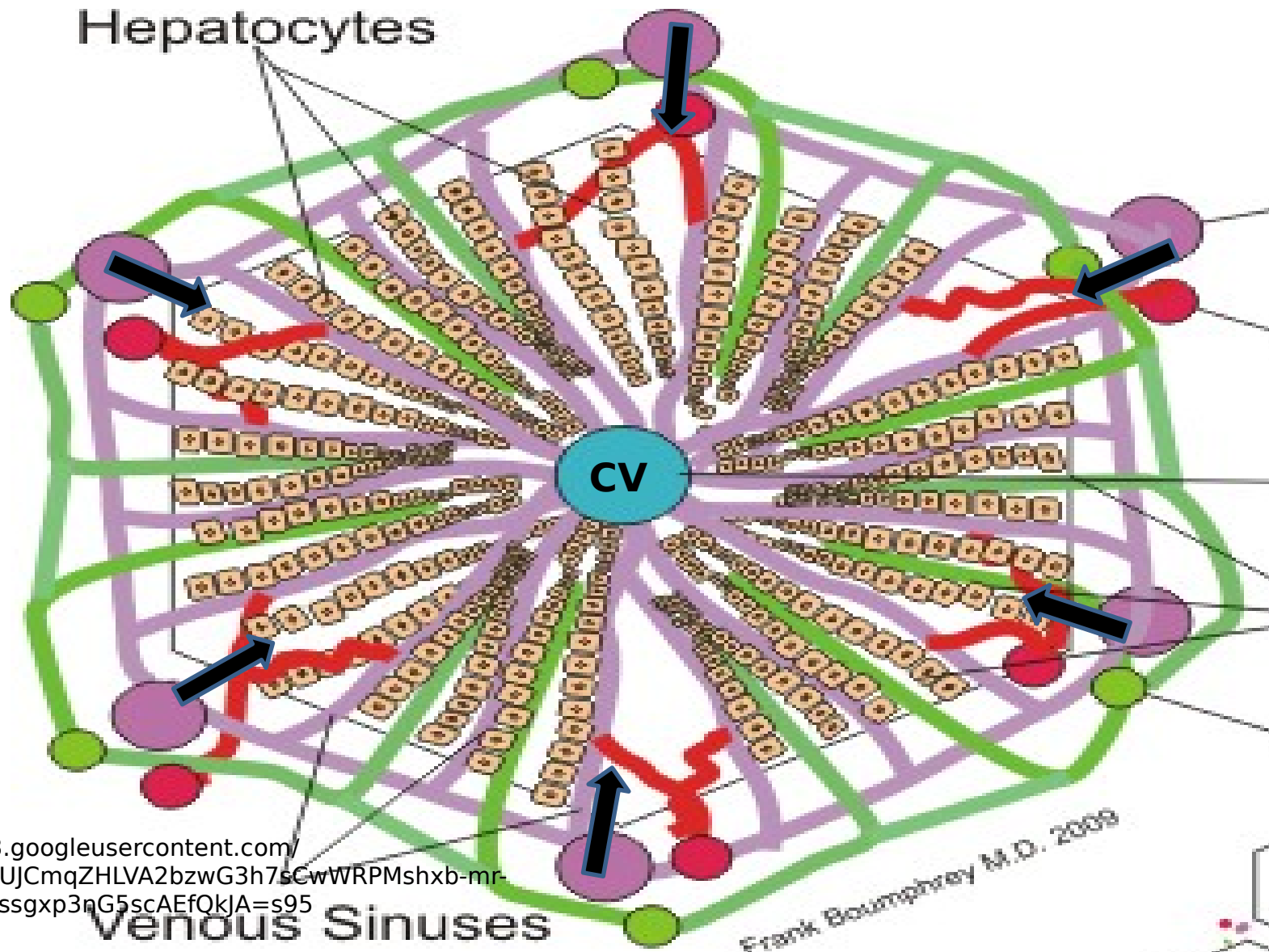


Which of the following is NOT a component of the portal tract?

- a. Branch of the hepatic artery.
- b. Branch of the portal vein.
- c. Branch of the bile duct.
- d. Branch of the hepatic vein.



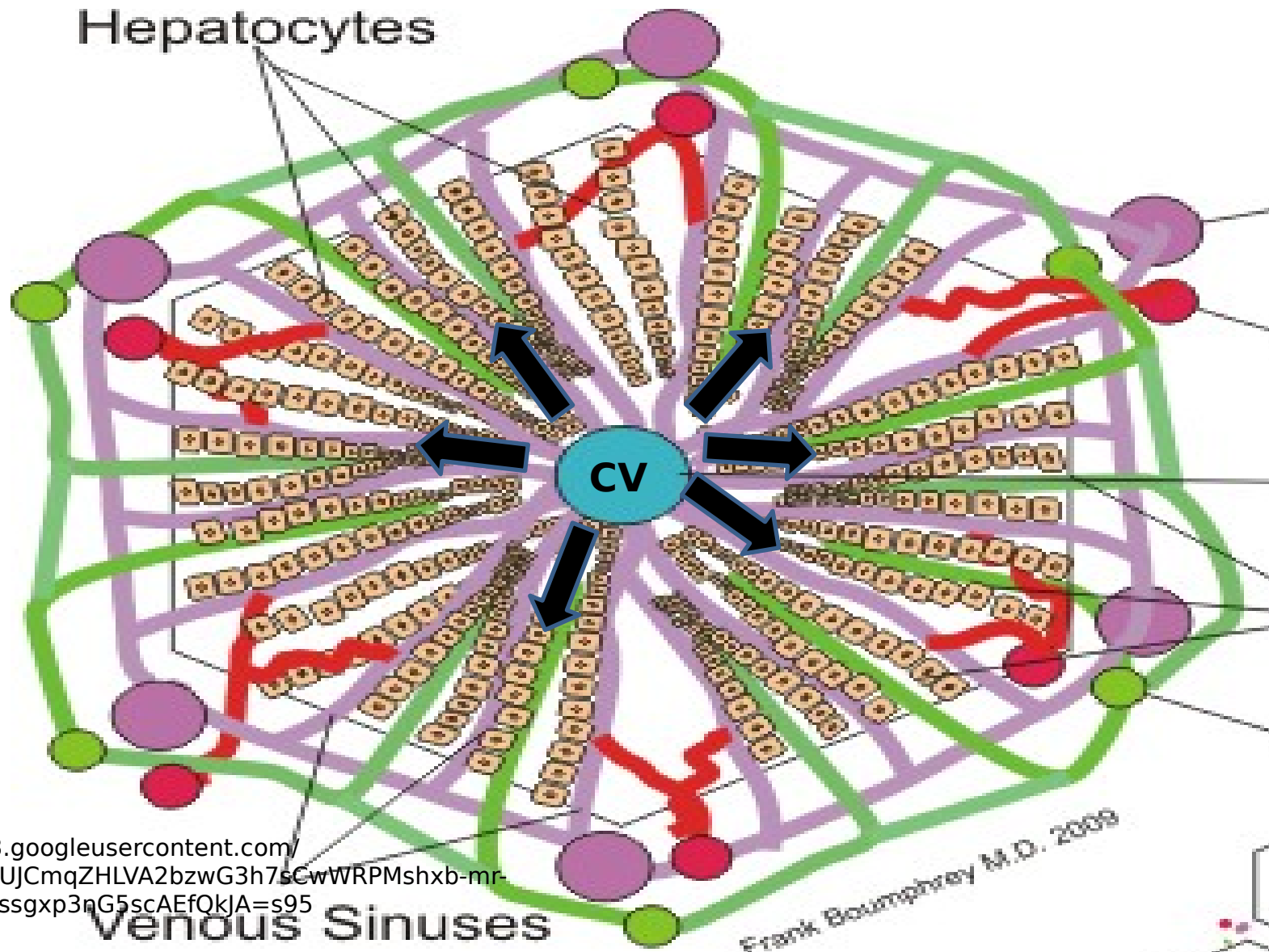
Direction of blood flow



<https://lh3.googleusercontent.com/vi80a7TrZUJCmqZHLVA2bzwG3h7sCwWRPMshxb-mrYgYCiJlI27ssgxp3nG5scAEfQkJA=s95>



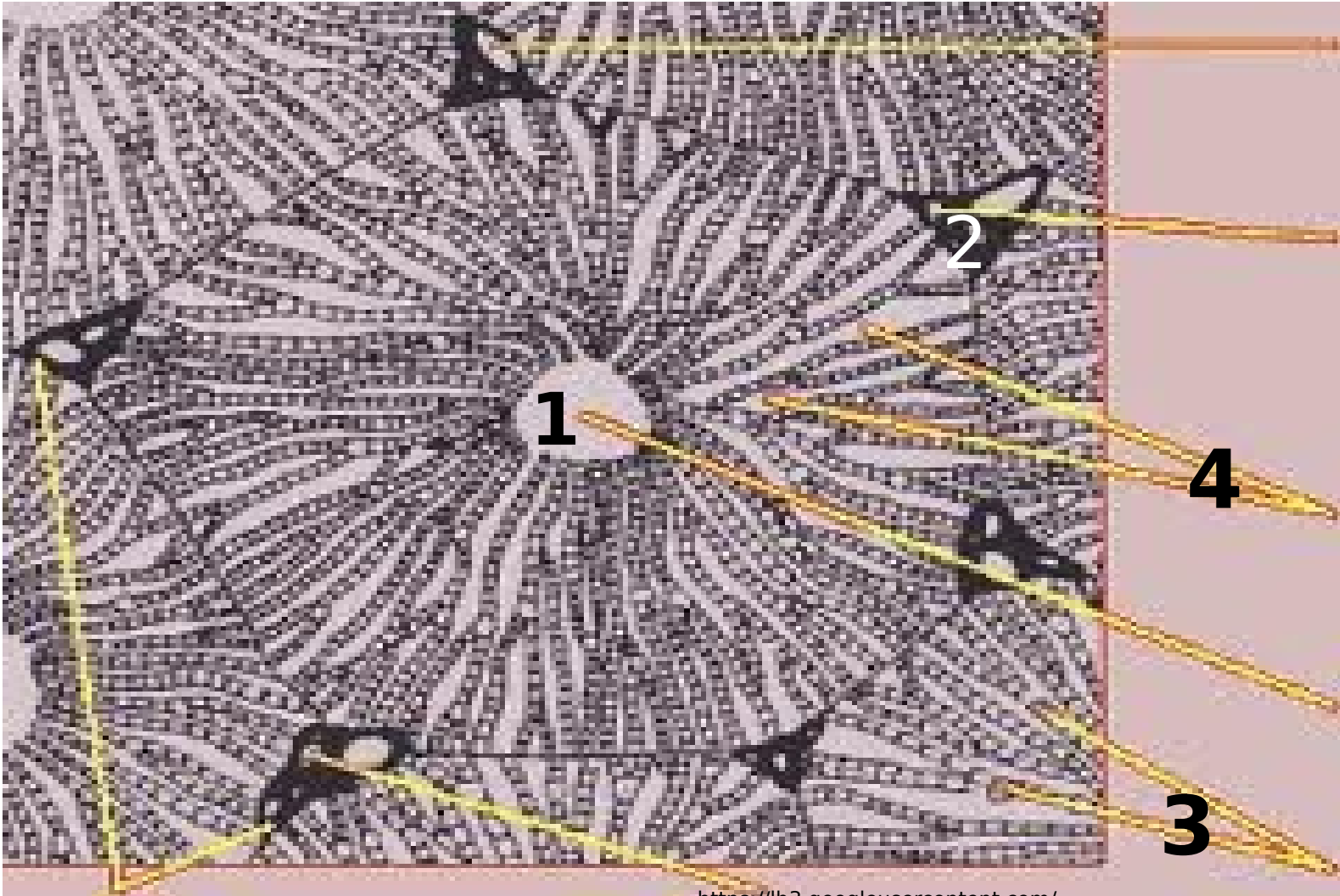
Direction of bile flow



<https://lh3.googleusercontent.com/vi80a7TrZUJCmqZHLVA2bzwG3h7ScWWRPMshxb-mrYgYCijlI27ssgxp3nG5scAEfQkJA=s95>



Classic Hepatic Lobule



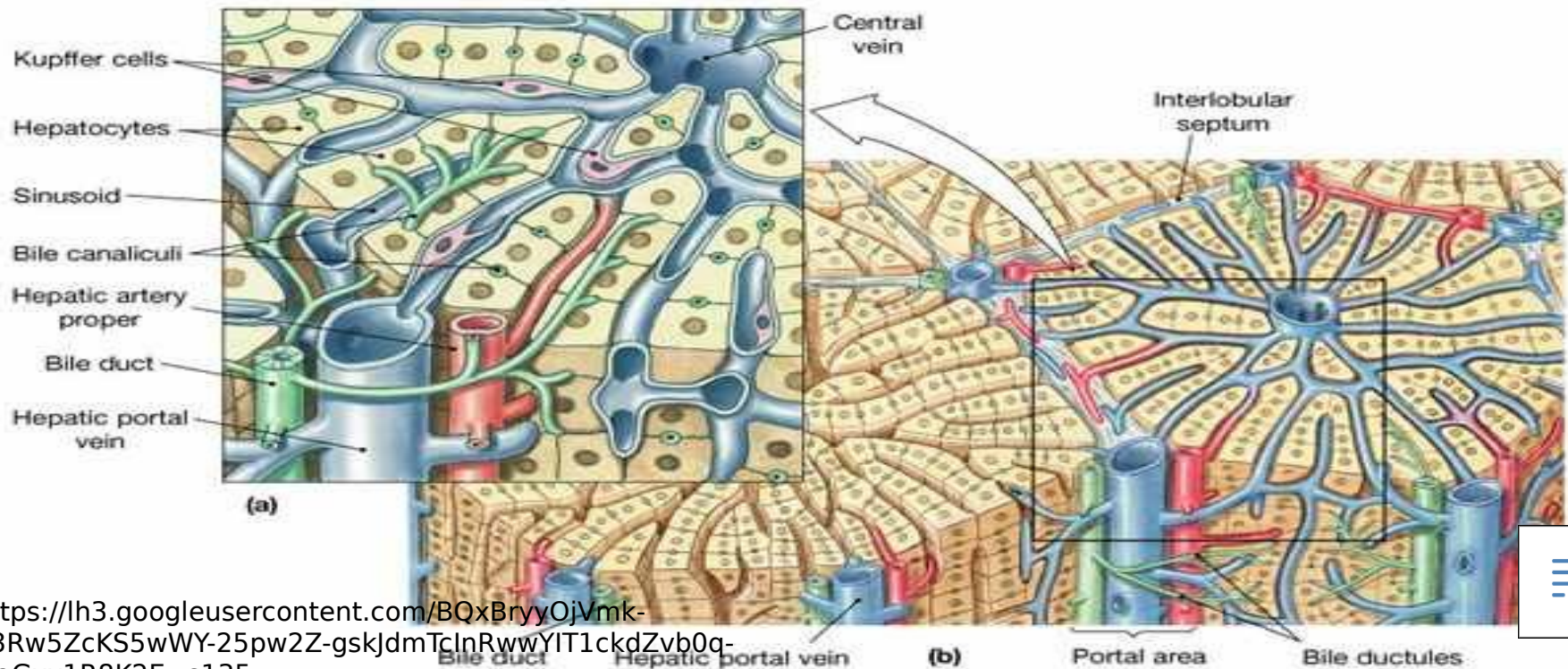
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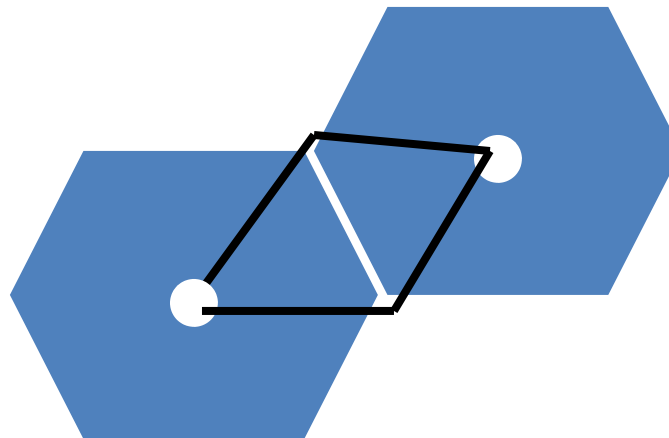
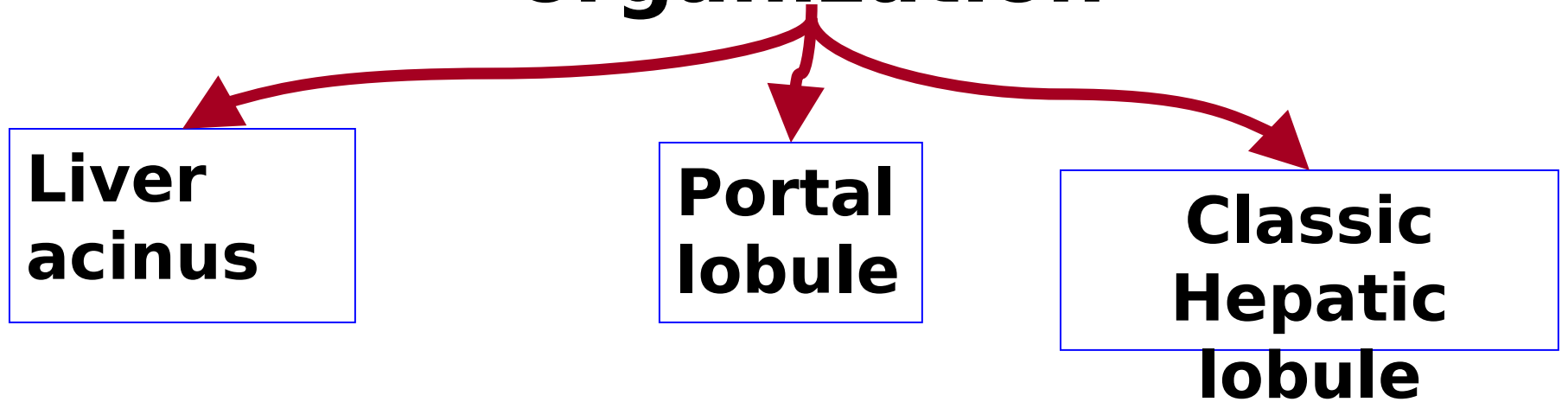
Blood Supply of the Liver



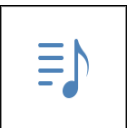
- The liver has two circulatory inputs:
 1. Hepatic artery (75%)
 2. Portal vein (25%)
- Blood from both sources is mixed within the



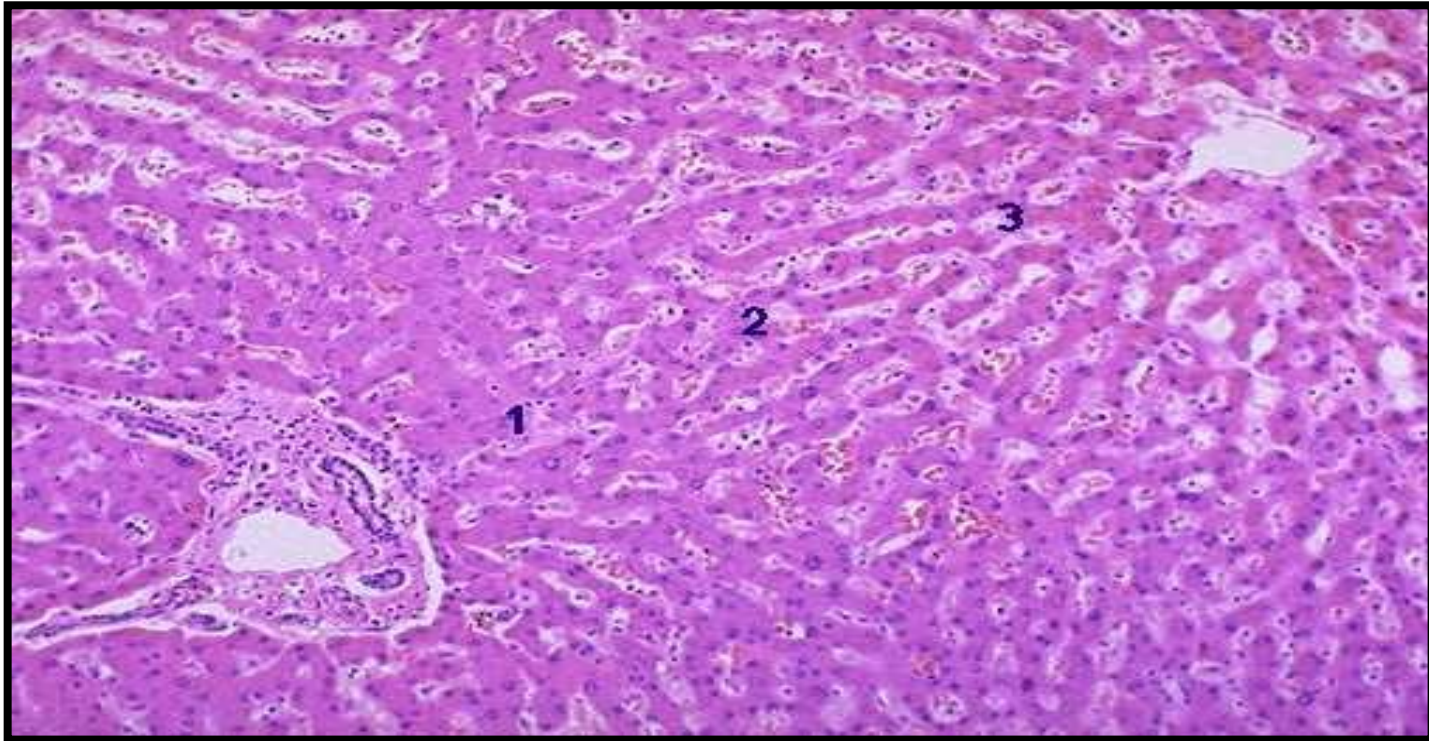
Classification of hepatocyte organization



**Diamond shaped mass from 2 classic lobules.
Central vascular core**



The Liver Acinus



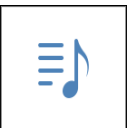
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Zone I: close to central vascular core.

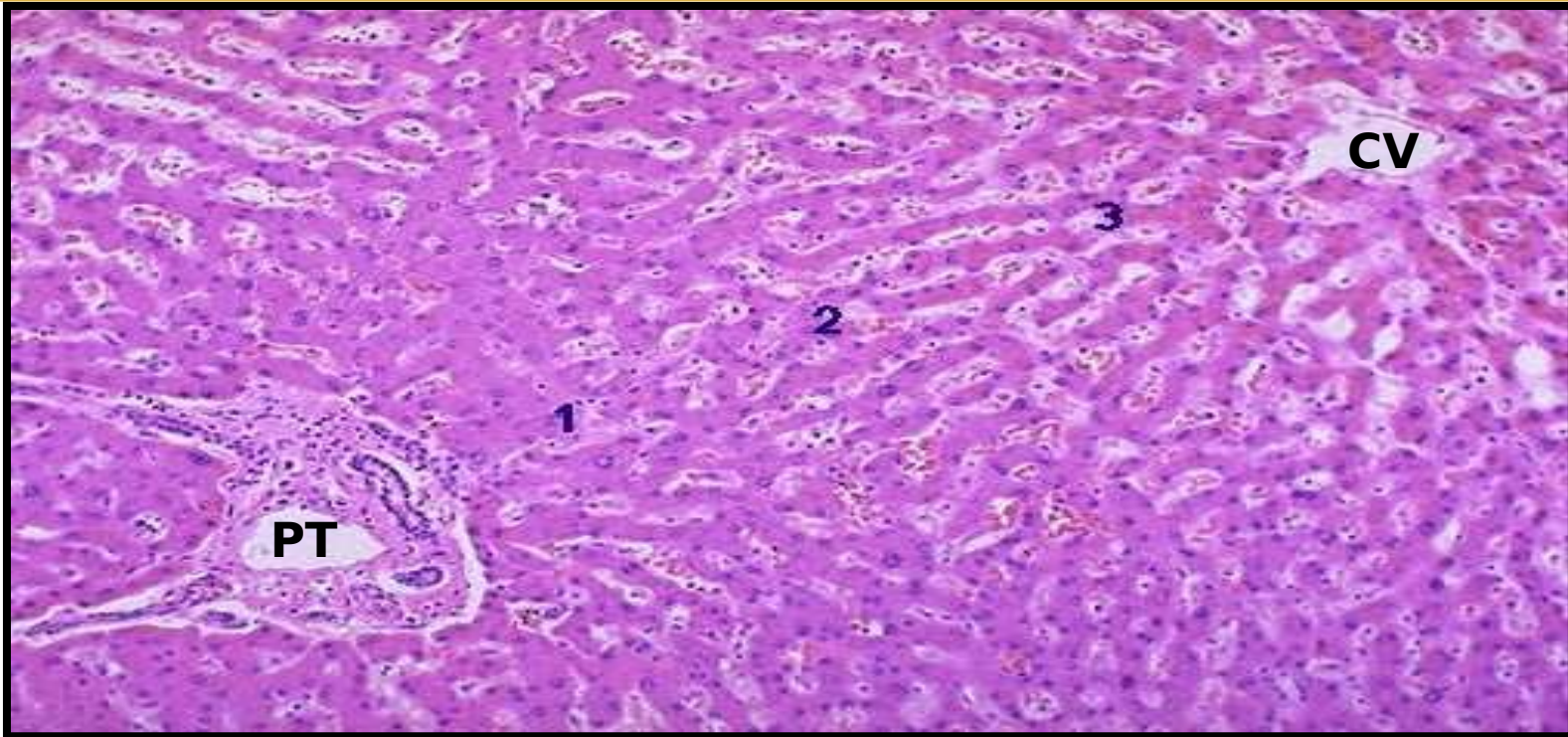
Best blood supply.

O₂, nutrients.

Synthesize glycogen and plasma proteins.



The Liver Acinus

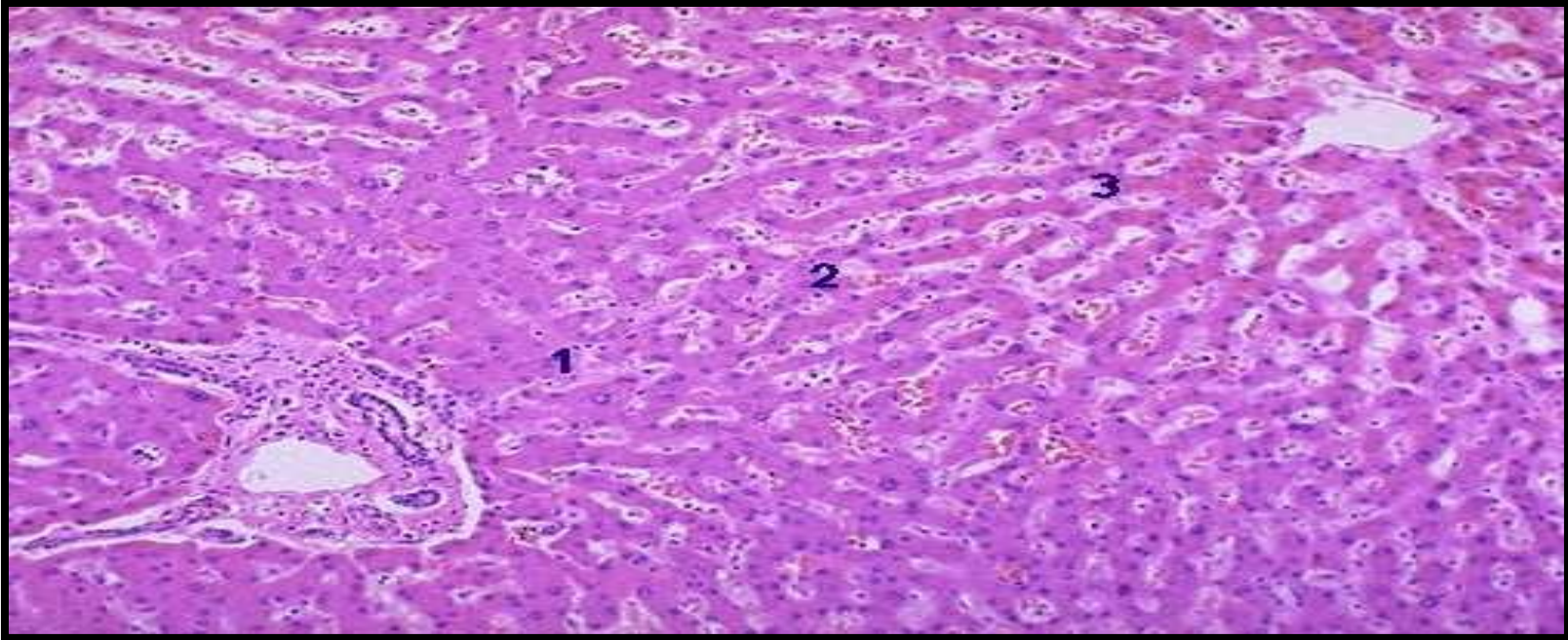


Zone II: surrounding zone I.
Less blood supply than zone I.
Intermediate range of metabolic functions between the two zones.

<https://lh3.googleusercontent.com/4u00tgzXdGgBHb2LpQ2ytJc4WGZk-17p0hmmumI6wx6Lv57gPkj4JnrFK0AYVQ1GvpbQHQ=s128>



The Liver Acinus



<https://lh3.googleusercontent.com/4u00tgzXdGgBHb2LpQ2ytJc4WGZk-17n0mmmmumI6wx6Lr57cPlu4JnxFK0AYQ1GvpbQHQ=s128>

Zone III: close to CV, far from vascular core.

Least blood supply.

Least O₂, nutrients.

High sER, (drug detoxification)

Concerned with glycolysis.

First to undergo ischemic necrosis.



Question



- Hepatocytes in zone 1 are characterized by which of the following?
 - a. They lie in close proximity to the central vein.
 - ☐ b. They are the most active in drug metabolism.
 - c. They have the best blood supply.
 - d. They have the least glucose supply.

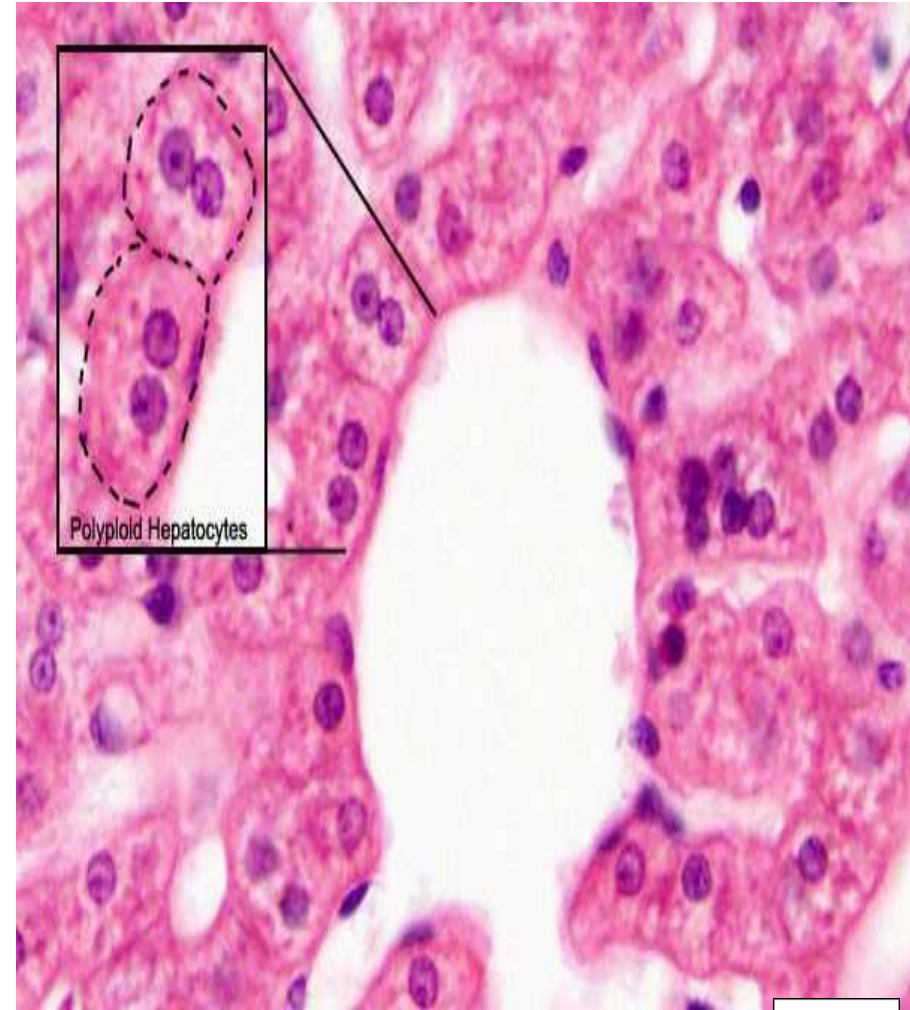


Histological Feature of Hepatocytes

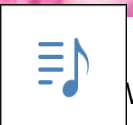


LM

- **Hepatocytes:**
large polygonal cells.
- **Nucleus:** central,
rounded & vesicular.
(25% binucleated)
- **Cytoplasm:**
acidophilic (numerous
mitochondria) + some
basophilic granules
(rER & free
ribosomes).
- **Vacuolations?**



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Histological Features of Hepatocytes



EM

- **Mitochondria:** numerous (1000 per cell) why?
- **RER:** numerous (protein synthesis: albumin, globulin and prothrombin).
- **Golgi:** multiple.
- **SER:** (detoxification, glycogenesis, conjugation of bilirubin.



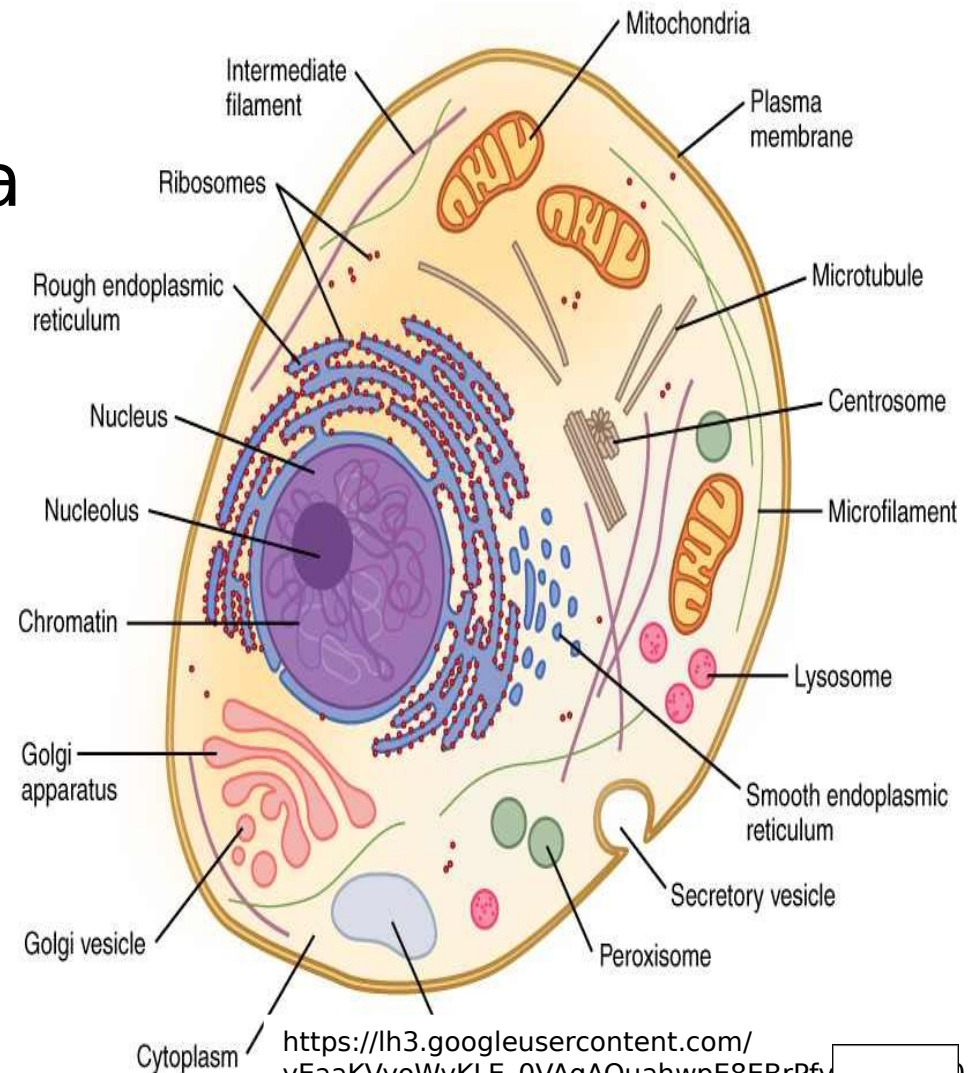
Mescher AL: Junqueira's Basic Histology: Text and Atlas, 14th Edition.
<http://www.accessmedicine.com>



Histological Feature of Hepatocytes



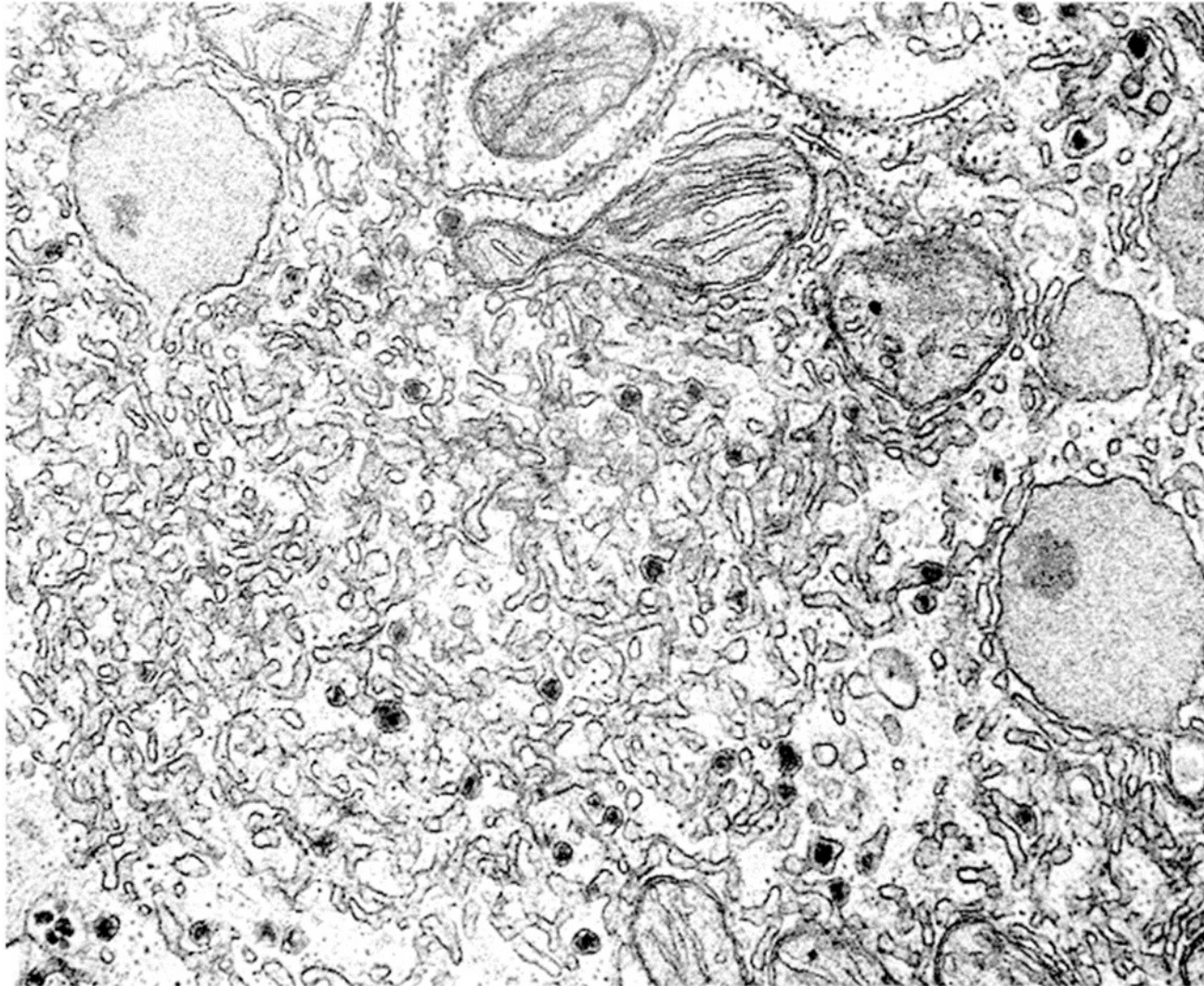
- ❑ **Lysosomes.**
- ❑ **Peroxisomes:** (break down fatty acids by β -oxidation).
- ❑ Actin, Intermed. Fs.
- ❑ **Inclusions:**
 - glycogen (rosettes)
 - fat droplets.
 - Lipofuscin pigment.



https://lh3.googleusercontent.com/yEaaKVyoWvKLE_0VAqAQuahwpE8EBrPfvxY47p9ZzTQAIAIOMr1Gwtf60TRDyg=s10



EM of Hepatocytes

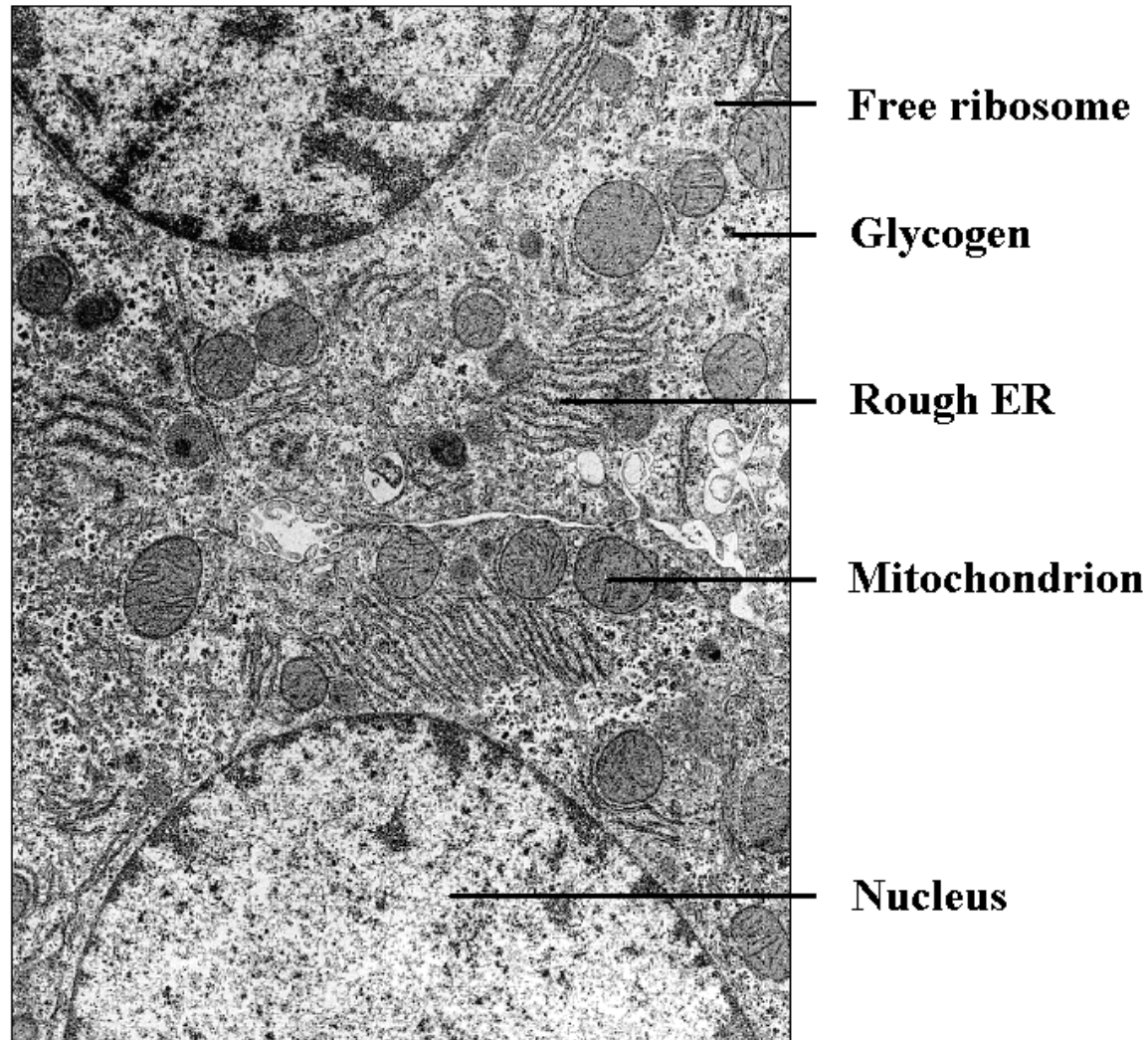


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https://lh3.googleusercontent.com/zznCbQG-nMp32vXwHheIRUcUU4tSn0tFjf362s6FA0pVc_N=s109



Histological Feature of Hepatocytes



Function of Hepatocytes



- **Exocrine function:** Bile which help in fat absorption.
- **Endocrine function:**
 1. Secrete glucose
 2. Plasma proteins (albumin, fibrinogen, globulin, and prothrombin) in blood directly. (rER)
 3. Lipoprotein formation (rER, sER).
- **Detoxication** of drugs as barbiturates (sER) and alcohol (peroxisomes)
- **Storage, metabolism of iron.**
- **Metabolic function:**
 1. CHO, Lipid , cholestrol.
 2. Urea formation.
- **Stores and converts many vitamins (A, D, K)**



Question



Which of the following best explains the vacuolation detected in hepatocytes by LM?

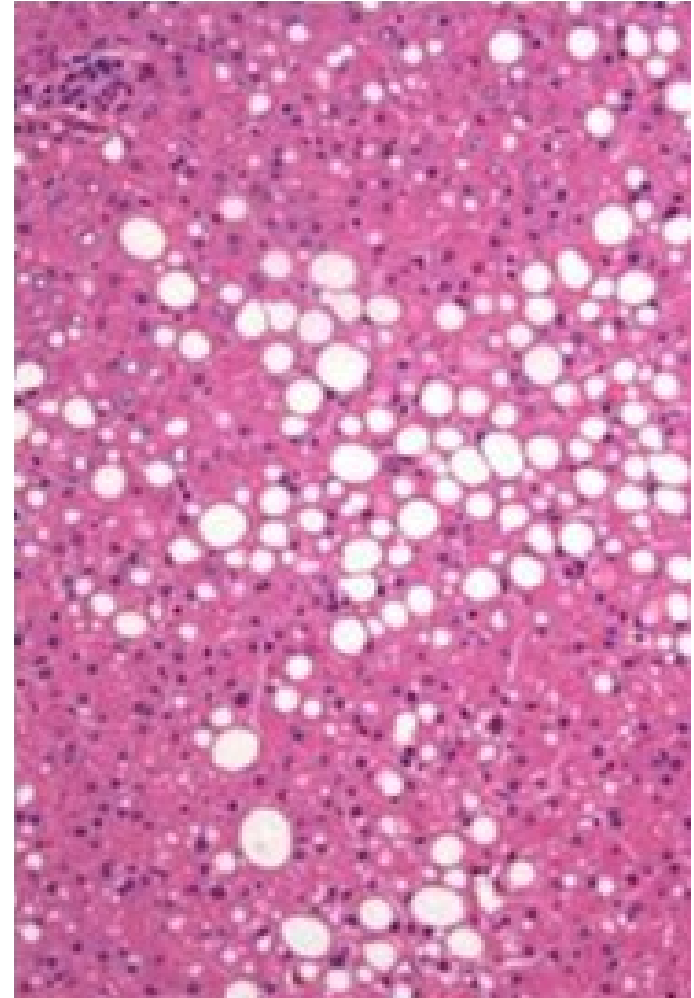
- a) Numerous mitochondria.
- ☒ b) Abundant peroxisomes.
- c) Fat & glycogen granules.
- d) Well-developed RER.
- e) Heterolysosome.



Medical Application



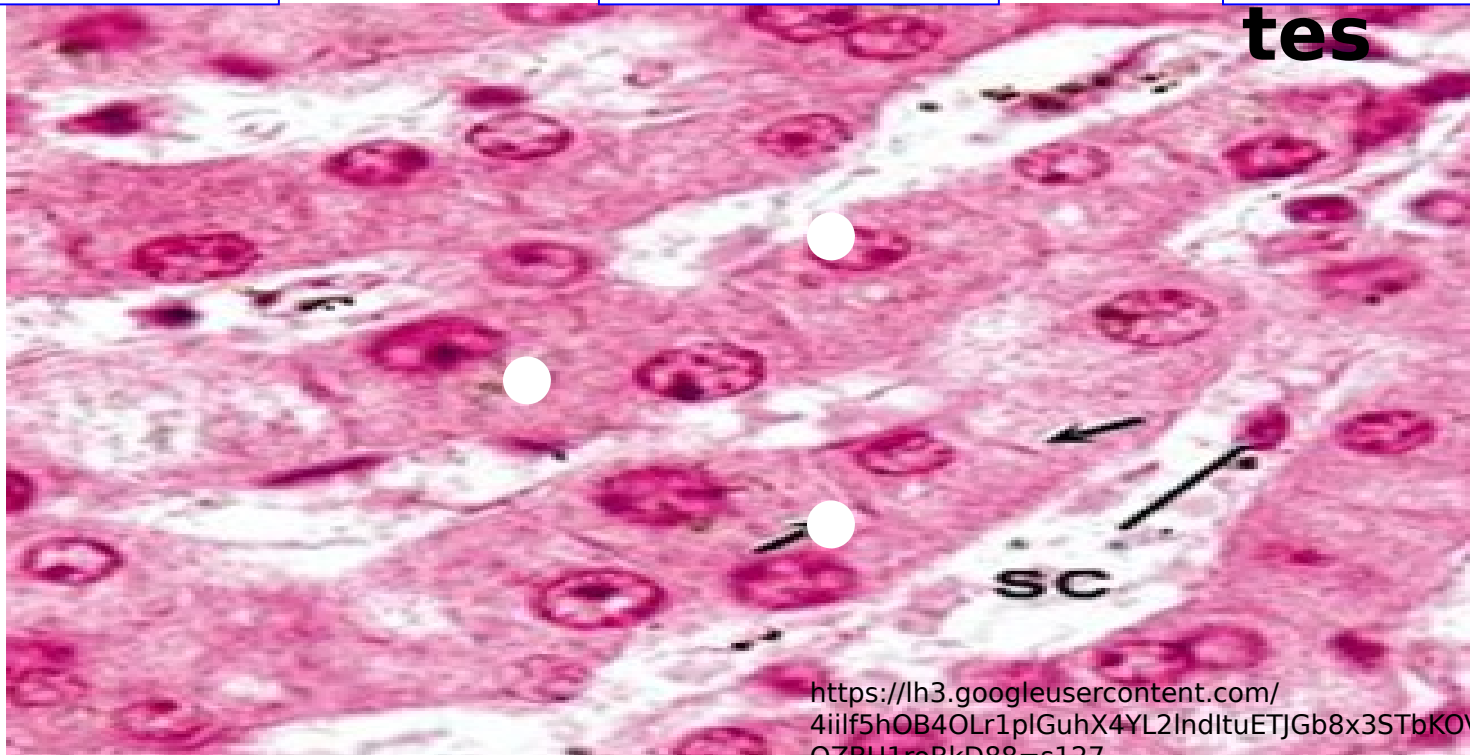
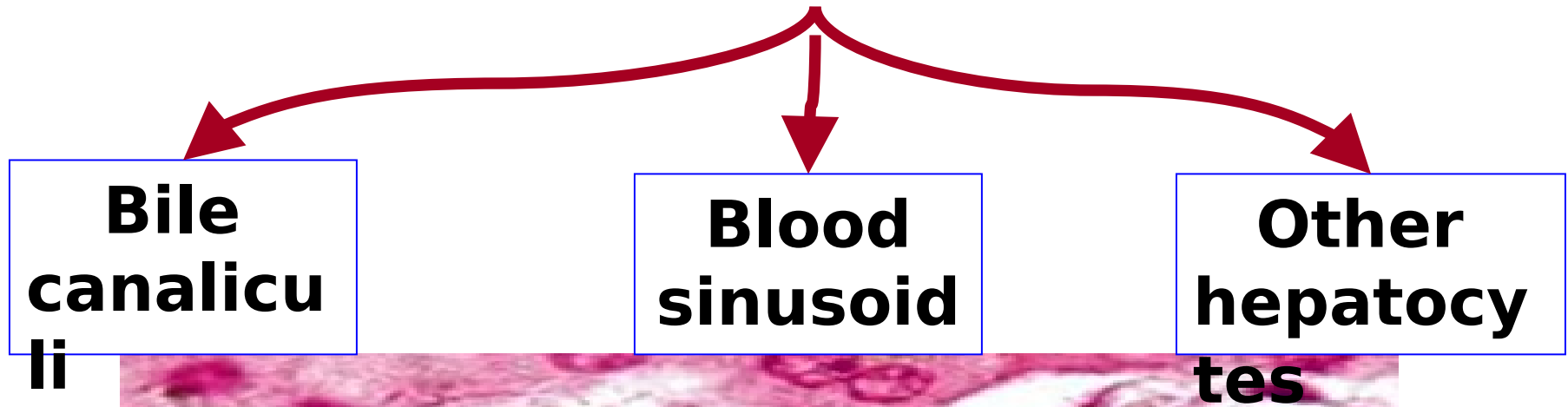
- **Fatty liver disease** is a reversible condition in which large lipid droplets accumulate abnormally in hepatocytes. This disorder has multiple causes, but it occurs most commonly in individuals with **alcoholism** or **obesity**. Accumulation of fat in hepatocytes may produce a progressive inflammation of the liver.



https://bestpractice.bmj.com/image/796/en-us/normal/796-1-highlight_default.jpg



Hepatocytes face either



<https://lh3.googleusercontent.com/4iilf5hOB4OLr1pIGuhX4YL2IndItuETJGb8x3STbKOVVWaOYgOZBU1roBkD88=s127>



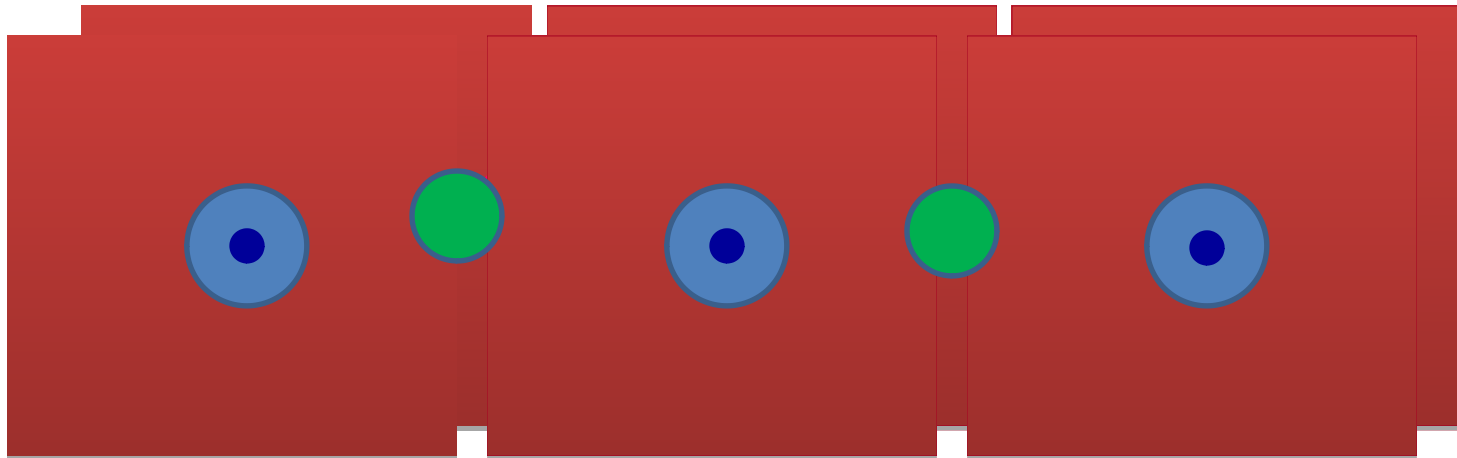
Hepatocytes have three surfaces



**Bile
canaliculi**

**Blood
sinusoid**

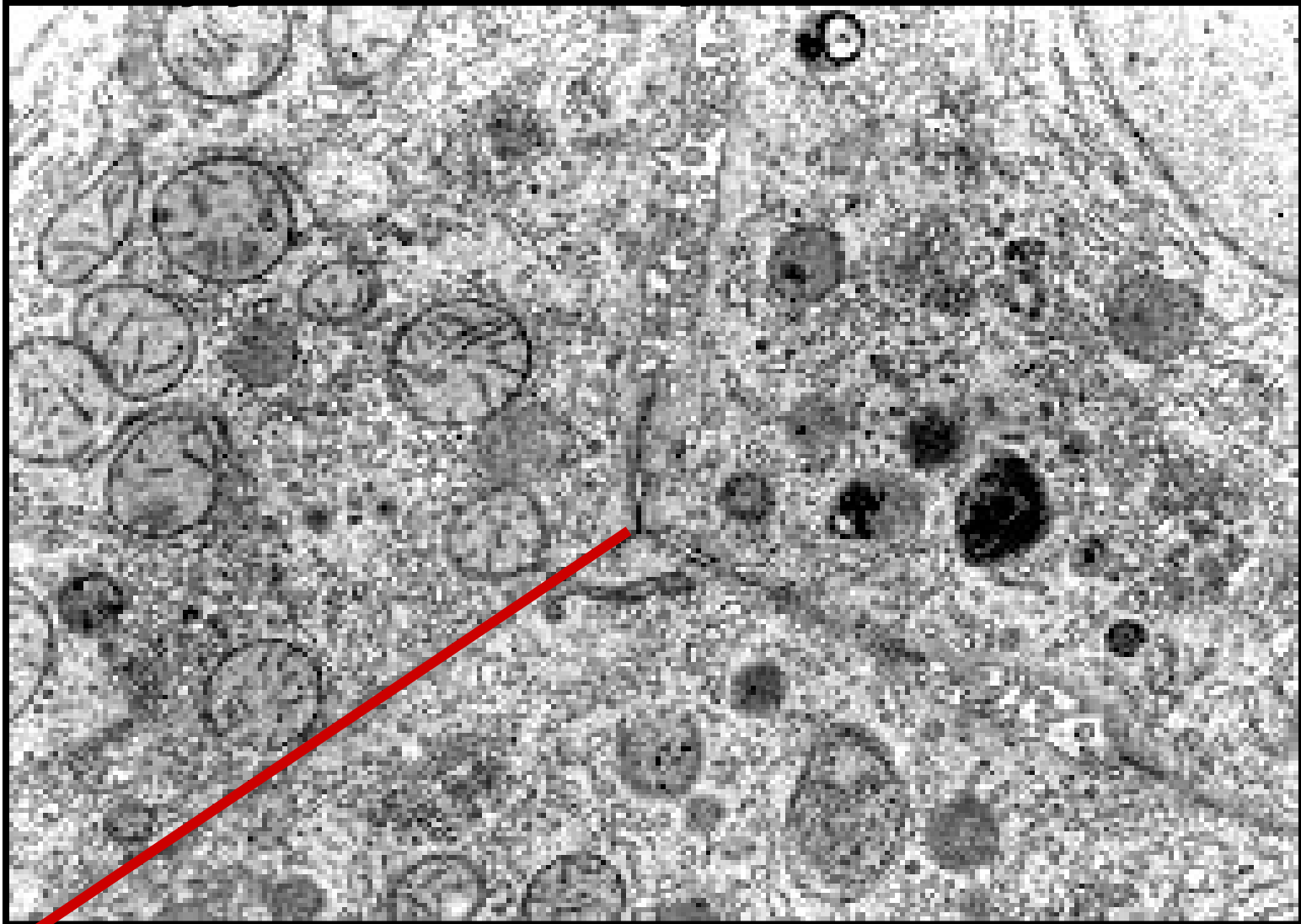
**Other
hepatocytes**



Surface facing other hepatocyte



Joined by junctional complexes



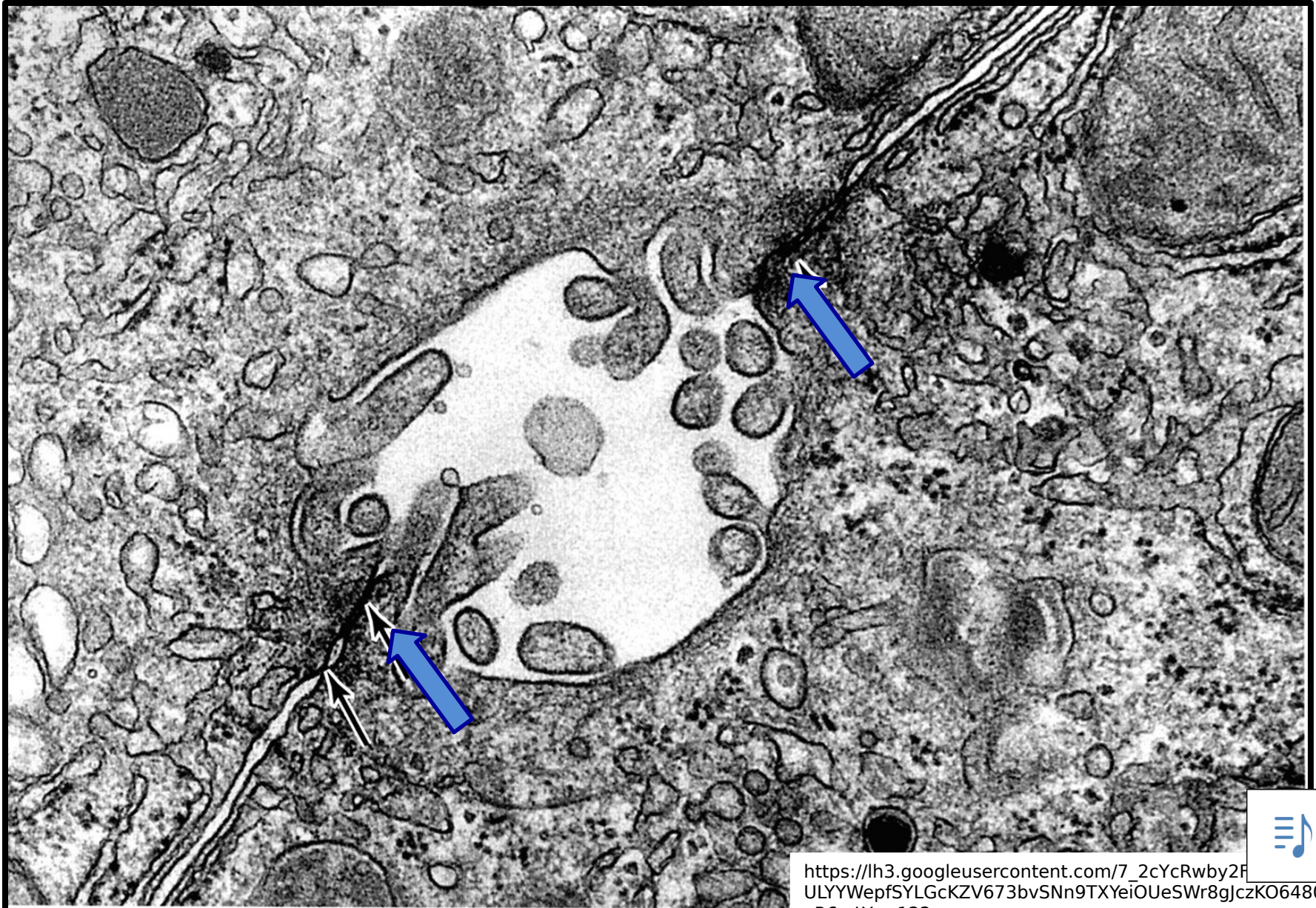
Surface facing bile canaliculus



- Contains short microvilli
- Bile secreted from hepatocytes in the bile canaliculi is the exocrine function of hepatocytes.



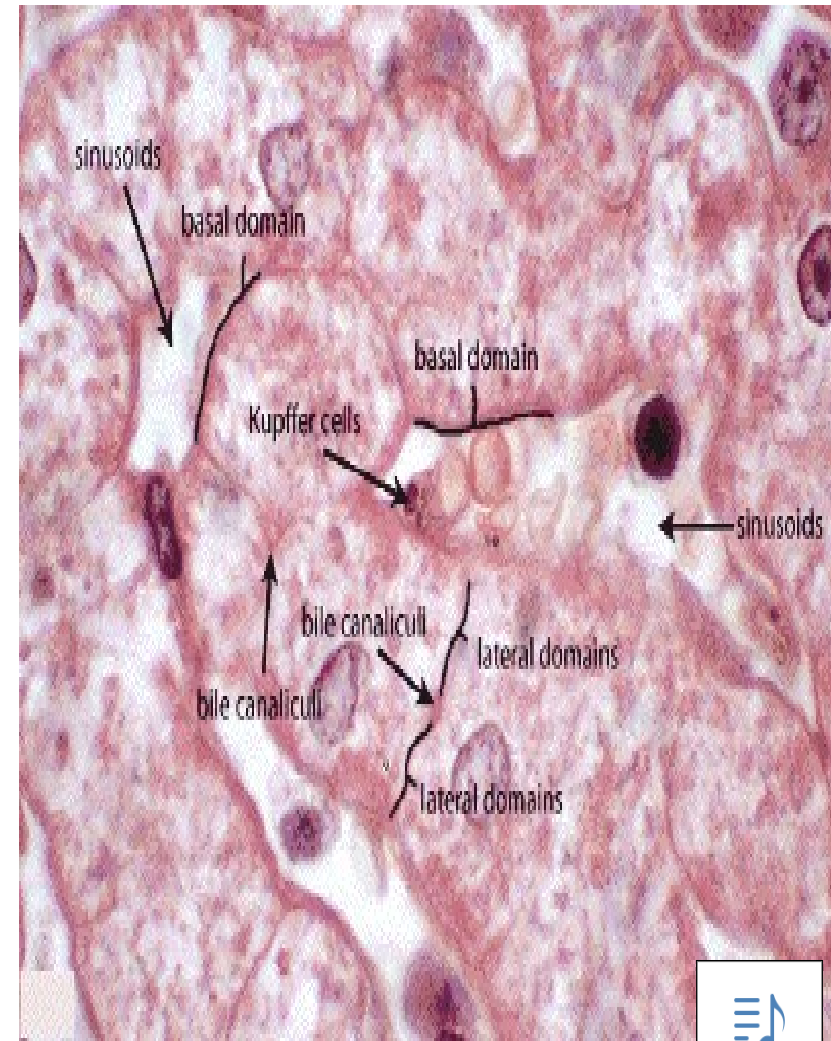
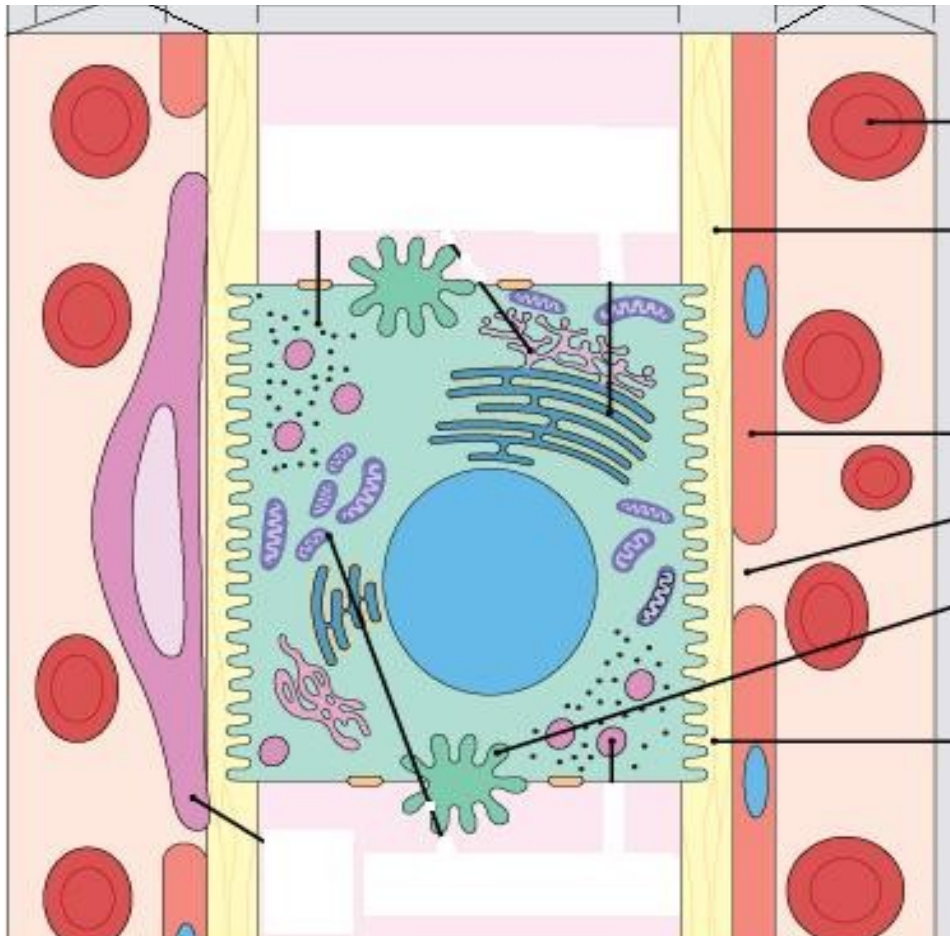
Surface facing bile canaliculus



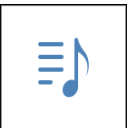
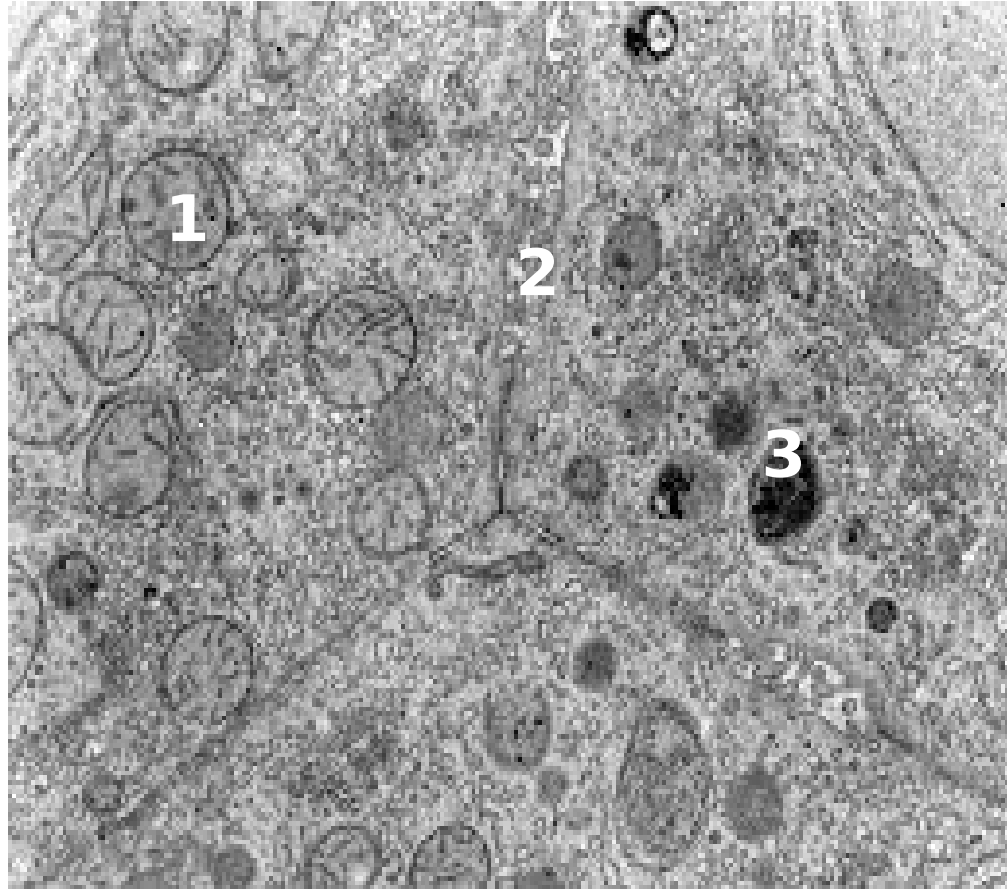
Surface facing blood sinusoid



- o Contains many long microvilli .
- o Why?



What are the numbered structures?



Question



Which of the following is true concerning the liver classification?

Central vein forms the center of the portal lobule

Vascular core forms the center of the liver acinus

Portal tracts form the periphery of the portal lobule

Portal tracts form the center of the classic hepatic lobules



Summary



Classification of the liver: classic hepatic lobule, portal lobule, liver acinus

The classic hepatic lobule is hexagonal in shape with a central vein and peripheral portal tracts.

The portal lobule is triangular and related to a central bile duct.

The liver acinus is diamond in shape and has a central vascular core

Hepatocytes are acidophilic and 25% are binucleated. By EM, all organelles are abundant.

Hepatocytes have three surfaces facing either bile canaliculi, another hepatocyte and blood sinusoid.



Suggested textbooks



- 1- Junqueira`s Basic Histology; Text and Atlas. 14th edition 2016, pp: 329-332.
- 2- Histology atlas and test: Michael H. Ross and Wojciech Pawlina, 7th edition, 2015, pp: 545-553



Thank You

